

# **SUMMARY OF ATRAZINE RISK ASSESSMENT**

**May 2, 2002**

## ***Uses***

- Atrazine is a triazine herbicide registered for the control of broadleaf weeds and some grassy weeds. Atrazine works by inhibiting photosynthesis.
- Atrazine is used on corn (field and sweet), sorghum, sugarcane, wheat (application to wheat stubble on fallow land following harvest), guava, macadamia nuts, hay, pasture, summer fallow, forestry or woodlands, conifers, woody ornamentals, Christmas trees, sod, and residential and recreational turf (parks, golf courses). Given the specific nature of the turf uses, much of atrazine's use on lawns is confined to Florida and the Southeast.
- Estimated 76.4 million pounds are applied annually. Usage on corn accounts for approximately 86% of total U.S. domestic usage (in pounds), followed by sorghum at 10% and sugarcane at 3% (all other uses take up the remaining 1%). Approximately 75% of the field corn acreage grown in the U.S. is treated with atrazine.
- Atrazine is formulated as an emulsifiable concentrate, flowable concentrate, water dispersible granular (dry flowable), soluble concentrate, wettable powder, granular, and as a ready-to-use formulation.
- Atrazine can be applied by groundboom sprayer, aircraft, tractor-drawn spreader, rights-of-way sprayer, hand-held sprayers, backpack sprayer, lawn handgun, push-type spreader, and bellygrinder.

## ***Metabolites***

- Atrazine is metabolized to four hydroxy compounds (found in plants) and to three chlorinated atrazine compounds, desethylated atrazine (DEA), desisopropyl atrazine (DIA), and diaminochlorotriazine (DACT - the terminal degradate). The chlorinated degradates are formed in animal tissues, and in soils and water.
- The chlorinated atrazine compounds are considered to be equal in toxicity to atrazine.
- The toxic effects of the hydroxy compounds (represented by hydroxyatrazine) are considered to be independent of the effects of atrazine, and have been assessed separately.

## *Human Health Effects*

### Atrazine and its Chlorinated Metabolites (Chlorotriazines)

- Atrazine has low acute toxicity.
- The toxicity endpoint for the acute dietary assessment is delayed ossification (offspring) and delayed body weight gain (adults). This endpoint is only relevant to the population subgroup females aged 13 to 50 because the developmental effects occurred through maternal exposure. (NOAEL = 10 mg/kg/day; LOAEL=70 mg/kg/day)
- The toxicity endpoint for the chronic dietary assessment and intermediate-term occupational and residential assessments is the attenuation of the surge of pre-ovulatory lutenizing hormone (LH). This endpoint is relative to all populations as a biomarker indicative of atrazine's ability to alter hypothalamic pituitary function (reproductive and developmental effects) (NOAEL = 1.8; LOAEL=3.65 mg/kg/day)
- The toxicity endpoint for the short-term occupational and residential assessments is delayed puberty. This endpoint is relative to all populations. (NOAEL =6.25; LOAEL=12.5 mg/kg/day)
- An FQPA Safety Factor of 10x was applied for dietary (food and drinking water) exposure; and an FQPA Safety Factor of 3x was applied for residential exposure
- After evaluation by the FIFRA Scientific Advisory Panel in June 2000, the Agency has classified atrazine as "not a likely human carcinogen" because the mode of action by which atrazine causes mammary gland tumors is specific to the female Sprague-Dawley rat.

### Hydroxyatrazine

- A toxicity endpoint for the acute dietary assessment was not identified as no acute toxicological effect was observed.
- The toxicity endpoint for the chronic dietary assessment is histological lesions in the kidneys. (NOAEL=1.0; LOAEL=7.75 mg/kg/day)
- The toxicity endpoint for the short-term assessments is decreased food consumption and renal effects. (NOAEL=25; LOAEL=125mg/kg/day)
- The toxicity endpoint for the intermediate-term assessments is renal lesions. (NOAEL=6.3; LOAEL=22.75 mg/kg/day)

- The toxicity endpoint for the long-term assessments is renal lesions, as well. (NOAEL=1.0; LOAEL=7.75 mg/kg/day)
- The FQPA safety factor was removed for hydroxyatrazine.
- The Agency does not consider hydroxyatrazine to possess carcinogenic potential.

## ***Risks***

### **Dietary Risk (Food)**

- Acute and chronic dietary risk from food is not of concern.

### **Dietary Risk (Drinking Water)**

- Risk estimates are based on a refined assessment that considers monitoring data.
- Assessments included atrazine and the chlorinated metabolites (chlorotriazines); hydroxymetabolites are not expected to be a significant contributor to drinking water risk.
- Limited sampling was done for the chlorinated metabolites.

### Community Water Systems (CWS) - Surface Water

- Acute (one-day) exposures do not exceed levels of concern. The maximum estimated one-day concentration of 89 ppb is less than the DWLOC of 298 ppb.
- 29 CWS assessed with either screening level or probabilistic methods had 91-day average (intermediate-term) exposures to chlorotriazines that exceeded levels of concern for infants (DWLOC of 12.5 ppb) at the 99.9th percentile.
- CWS of concern are located in Illinois, Iowa, Louisiana, Indiana, Kentucky, Missouri, and Ohio.

### Rural Wells

- Acute (one-day) exposures do not exceed levels of concern. The maximum measured value of 18 ppb is less than the DWLOC of 298 ppb.
- 8 out of 1505 rural wells sampled once or twice, several years apart, had concentrations of chlorotriazines greater than the infant DWLOC of 12.5 ppb and exceed levels of concern.
- Exposures not well characterized for rural wells due to limited sampling.

### CWS - Groundwater

- Acute exposures do not exceed levels of concern. The maximum measured value of ~11 ppb is less than the DWLOC of 298 ppb.
- Chronic exposures do not exceed the DWLOC of 12.5 ppb.
- CWS using groundwater are not impacted as heavily by atrazine use as CWS using surface water.

**Residential Risk** is of concern for the following exposure scenarios (MOEs are less than the target MOE of 300):

- Homeowners who apply granular atrazine via bellygrinder to 0.5 acres (MOE = 66)
- Adults and children who play on wet turf following the application of liquid atrazine formulations (MOEs=190<sub>adult</sub> and 110<sub>children</sub>)
- Children who play on turf following the application of liquid atrazine formulations through hand to mouth activity (MOE=210)
- Children who play on turf following the application of granular atrazine formulations and eat granules (MOEs range from 16 to 110)
- Residential aggregate exposures (dermal and oral exposures) to children who play on turf following the application of liquid atrazine (MOE=190)

### **Aggregate Risk**

#### Acute aggregate risk

- Combines high-end one day exposures in food and drinking water.
- Acute aggregate risk does not exceed levels of concern; risk is the same as for drinking water because food exposure is insignificant.

#### Chronic and intermediate-term aggregate risk

- Combines average exposures in food with seasonal or annual average exposures in drinking water.
- Chronic and intermediate term aggregate risk is of concern; risk is the same as that for drinking water exposure alone because exposure through food is insignificant.

#### Short-term aggregate risk

- Combines average exposures in food and/or seasonal drinking water with high-end short- term residential exposures.
- Short-term aggregate risk is of concern, as follows:
  - Dermal and dietary exposures exceed levels of concern for adults and children,
  - Dermal, dietary, and incidental oral exposures exceed levels of concern for children,
  - Dermal and dietary exposures exceed levels of concern for adults applying granular formulations of atrazine via bellygrinder.
- Short-term risk estimates are the same as the residential risk estimates.

### **Occupational Risk**

#### Handler

- Risk estimates do not exceed levels of concern for short-term exposure to handlers with protective equipment or engineering controls.
- Risk estimates exceed levels of concern for intermediate-term exposure for handlers of large quantities of atrazine (i.e., to treat large acreage)

#### Postapplication

- Risk estimates are of concern for postapplication scouting of sugarcane

### **Ecological Risk**

#### Population and Community Level Risk

- Reductions in primary productivity
- Reductions in populations of aquatic macrophytes, invertebrates, and fish
- Loss of sensitive species in aquatic communities, resulting in changes in community structure and function
- Effects are likely to be greatest where concentrations of atrazine in water recurrently or consistently exceed 10 to 20 ppb
- Reported Sub-Lethal Effects
  - Endocrine effects in bass and frogs, and olfactory effects in salmon have been attributed to atrazine in some studies.
  - Other studies have shown no effects in frogs, *Daphnia*, alligator eggs, and turtle eggs.
  - Additional research to investigate these findings is ongoing.

#### Direct Avian and Mammalian Risk

- Atrazine is slightly acutely toxic and chronically toxic to birds and mammals.
- Use is not expected to result in acute RQs greater than the level of concern (LOC) of 0.5.
- Use is expected to result in chronic RQs that may exceed the LOC of 1. Chronic RQs range from less than 1 to 4 for birds, and from 1.6 to 96 for mammals.

#### Direct Aquatic Species Risk

- Atrazine is moderately acutely toxic to freshwater fish and highly acutely toxic to aquatic invertebrates. Atrazine is chronically toxic to fish and aquatic invertebrates.
- Use is not expected to result in acute RQs greater than the LOC of 0.5.
- Use is expected to result in chronic RQs that may exceed the LOC of 1. Chronic RQs for freshwater fish range from less than 1 to 3.1, and from less than 1 to 3.4 for freshwater aquatic invertebrates.

#### Direct Non-Target Terrestrial and Aquatic Plant Risk

- Atrazine is very highly acutely toxic to non-target terrestrial and aquatic plants.
- Use is expected to result in RQs that may exceed the LOC of 1. RQs range from less than 1 to 280 for 8-9 species of non-target terrestrial plants and from less than 1 to 5.5 for algae and aquatic vascular plants.